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Regional Cluster Development Measures and  
New Technology Based Firms Cultivation in Japan

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## **Abstract**

The aim of this paper is to reveal significant factors within a cluster that influence the fostering of new technology based firms (hereafter abbreviated NTBFs) and determine which measures should be given priority in aiding regional improvement.

In this paper, a questionnaire survey was conducted with project directors of regional knowledge cluster headquarters promoted by the Ministry of Education, Culture, Sports, Science and Technology, NTBFs, as well as, external specialists such as attorneys, patent attorneys, certified public accountants, and venture capital firms. The questionnaire survey revealed that “diffusion of technology and knowledge” is most highly valued for function of basic research, “customer” for product development function and sales function, regarding cluster features identified of being importance in locating each of the company’s functions. Secondly, while not only NTBFs but also both external specialists and knowledge cluster project directors recognize the importance of “workforce and human resources” in the cultivation of NTBFs in the clusters. Lastly, NTBFs have request in maximizing the potential use of universities, existing facilities and measures based on the survey results, policy implications concerning the knowledge cluster initiative will also be discussed.

## **1. Introduction**

New technology based firms (hereafter abbreviated NTBFs) are defined in this paper as innovative and progressive small firms pursuing leading-edge technology businesses based on technological inventions and focusing on their own intellectual properties, especially legally-protected patents. Technology venture development is believed to be a source to revitalizing regional economies. This consequentially makes NTBFs the potential contributors to the regaining of regional competitiveness.

The aim of this study is to reveal significant factors within a cluster that influence the fostering of NTBFs and determine which measures should be given priority in aiding regional improvement. A questionnaire survey was conducted with project directors of regional knowledge cluster headquarters promoted by the Ministry of Education, Culture, Sports, Science and Technology (hereafter abbreviated MEXT), NTBFs, as well as, external specialists such as attorneys, patent attorneys, certified public accountants, and venture capital firms (hereafter abbreviated VCFs). Based on survey results, policy implications concerning the knowledge cluster initiative will also be discussed.

## **2. Prior research on regional clusters**

The concept of clusters was introduced to refer to a group of interconnected firms, players or related institutions which are located in the same location (Porter, 1990). According to Porter (1990: 71), the development of clusters can influence competitiveness of an industry in many ways. The degree of success depends on the outcome of interlinked four determinants and the interconnected activities among players in the clusters. The four determinants in this “diamond model” are factor conditions—the conditions of key factor such as skilled labor, capital and infrastructure, demand conditions—the nature of domestic demand for industry’s products or services, related supporting industries—the presence or absence of upstream and downstream industries in the supply of information exchanges and sharing of ideas, and

strategy, structure and rivalry of firms—the nature of domestic rivalry and conditions of how companies are created, organized and managed. Porter (1998) claimed that this model suggests a framework for analyzing which factor is promoting or obstructing the creation of competitive advantage of clusters and is useful not only in the national level, but also in the regional scope. Although not utilizing the word “cluster” as Porter, Marshall (1890) published a pioneering research on the concentration of specialized industries in particular geographic locations. According to Marshall(1890), there are at least three advantages for putting industries in particular localities—the pooled market for workers with specialized skills, development of subsidiary industries, and creation of technological spillover.

With regard to technology-oriented cluster, Smilor, Gibson and Kozmetsky (1989) proposed a conceptual framework of “Technopolis” or a new form of city-state centered around high-tech industry where seven segments in the “Technopolis Wheel” interact. The framework is a result of a study on the dynamics of high-technology development and economic growth in Austin, Texas. The seven segments described in this technopolis wheel are university—engineering, business, natural science, research centers, and others, large corporations—Fortune 500 HQ/branches, major sales and/or R&D, and major employers, emerging companies—university spin-offs, large company spin-offs, and other, federal government—defense spending, and sponsored research, state government—programs, and education support, local government—infrastructure, competitive rates, and quality of life, and support groups—community, chamber, and business.

Clusters can also generate regional advantages. Saxenian (1994) conducted a comparative research of why Silicon Valley was successful in adapting to the changing patterns of international competition while Boston’s Route 128 appeared to be losing its competitive advantage. The study reveals that Silicon Valley possessed a regional network-backed industrial system that promotes collective learning and flexible adjustment among specialized producers of related complex technologies. On the other hands, Route 128 region was dominated only by a small number of relatively integrated corporations. According to Saxenian, regional industrial systems are comprised of local institution and culture, industrial structure and corporate organization in which are closely interconnected (Saxenian, 1994: 7).

### **3. Japanese regional cluster projects**

Japanese government has included technology development as a part of national planning and put primary focus on the formation of regional clusters. There are currently at least two ongoing projects by Japanese government in promoting clusters—the industrial cluster plans promoted by the Ministry of Economy, Trade and Industry (hereafter abbreviated METI), and knowledge cluster initiative pushed forward by MEXT.

METIs’ industrial cluster plans put primary focuses on facilitating the formation of personnel networks made up of diverse groups of key players including enterprise managers, technical experts, researchers, and financiers. These players cooperate and compete with each other having an aim to drive their industrial clusters to become regional competitive. Industrial clusters are expected to serve as nurseries for new businesses of middle-standing enterprises and SMEs (METI, 2002).

The knowledge cluster initiatives promoted by MEXT are projects aiming to create concentrations of internationally competitive technological innovation through cooperation of R&D companies and related

research institutions. The projects primarily focus on human gatherings organized closely around knowledge creation bases namely universities and public research institutions, while also place proper attention to the autonomy of local governments in assisting the establishment of venture enterprises. Once local businesses become revitalized, these businesses along with R&D companies are also expected to come into the circle and eventually form clusters (MEXT, 2002A).

Both of the initiatives share similar primary goal of cultivating NTBFs, although in different forms – as various new businesses of middle-standing enterprises and SMEs for METI's, and R&D-based companies including university spinoffs for MEXT's.<sup>2</sup> However, having placed a high focus on cultivating NTBFs through the creation of R&D companies based on knowledge created within existing universities and public research institutions, MEXT's knowledge cluster initiative is selected for this study.

#### **4. Research questions and methodology**

There are two main research questions for this paper—1) which factors within a cluster are important in fostering NTBFs?, and 2) which measures are necessary for the enhancement of knowledge clusters environment for NTBFs? Regarding these two research questions, three sets of questionnaire-based survey were conducted with NTBFs, a number of external specialists including attorneys, patent attorneys, certified public accountants, and VCFs, and project directors of MEXT's initiated knowledge clusters' headquarters across the nation.

The first questionnaire set was carried out with the managers and employees of NTBFs who attended a distance learning program offered by Nara Institute of Science and Technology. Among all attendees, 184 business entities seeking to establish businesses based on intellectual properties, including patents, were surveyed through questionnaires delivered via postal or electronic mails between mid-November and December 2004. A total of 116 business entities responded, having a response rate of 63 percent. Out of these 116 responding entities, 47 unlisted companies currently applying for or have already obtained patents were identified and selected for study in this paper. The second set of questionnaires was delivered by postal mail in mid-November 2004 to all project directors of 16 knowledge cluster headquarters in Japan specified by MEXT. 13 knowledge cluster headquarters responded, having a response rate of 75 percent.

The last set of questionnaires was directed to external specialists including VCFs listed on the “Japan Venture Capital Directory” published by Venture Enterprise Center in 2003, and patent attorneys, attorneys, and certified public accountants who participated in a bio-venture supporting project, a joint effort by Kinki Branch of Japan Patent Attorneys Association, the Japanese Institute of Certified Public Accountants Kinki Chapter and the Osaka Bar Association (hereafter abbreviated the three association's group). The questionnaires were distributed in mid-November 2004 to 109 VCFs and 83 external specialists via postal mail. There were 32 responses from VCFs (response rate of 29 percent) and 28 responses from the three association's group (response rate of 34 percent). Among the responded external specialists, there were 7 attorneys, 9 patent attorneys, and 12 certified public accountants.

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2 With regard to the differences between METI's industrial cluster plans and MEXT's knowledge cluster initiatives, MEXT points out that knowledge clusters are distinctive from industrial clusters in the sense that the latter is an accumulation of various forms of firms and institutes, while the former is a gathering of local universities and research institutions with unique R&D themes and potentialities (MEXT, 2002B).

## **5. Results**

### **5.1 NTBFs' recognition**

There were seven attributes given as answer choices in this questionnaire in evaluating the constitution of clusters. The attributes were chosen based on Porter (1990), Marshall (1890), Smilor, Gibson and Kozmetsky (1989). The identified features of the clusters are “workforce and human resources — the availability of good human resource for necessary research, product development, and sales (WHR)”, “components other than workforce and human resources — the development of necessary infrastructure such as communications and distributions (COT)”, “customers — the immediate access to customer needs (CUT)”, “intra-industry competition — the existence of competitors for mutual growth (IIC)”, “related industries — the instant face-to-face access to cooperative institutions within a cluster such as device suppliers and distributors (REI)”, “supporting industries — the instant face-to-face access to external institutions or experts such as patent attorneys and venture capitalists for consultation (SUI)”, and “diffusion of technology and knowledge — the interactive exchanges of technology and knowledge with various people in the clusters (DTK)”.

The first set of questionnaires addressed to NTBFs questioned the extent to which each of the listed attributes influence the location of companies in a cluster. Localities in this survey were broken down further into locations for aggregated functions of a company, and particular functions involved in commercialization process, i.e. locations of basic research, product development and sales departments, separately. The respondents were to choose among different degrees of influence, between great influence (level 4), some influence (level 3), little influence (level 2), and no influence (level 1).

Regarding cluster features identified of being importance in locating each of the company's functions, “diffusion of technology and knowledge” is most highly valued followed by “customers” for function of basic research, “customer” and “workforce and human resources” for product development function and “customer”, “workforce and human resources” and “components other than workforce and human resources” for sales function. NTBFs also relatively recognize the importance of “workforce and human resources” for each stage of commercialization from basic research through product development and sales (see table 1).

**Table 1: The degree of influence of cluster features on the localities of company's functions by NTBFs**

	Research	Product Development	Sales
WHR	2.29	2.35	2.11
COT	1.89	2.00	2.11
CUS	2.34	<b>2.42</b>	<b>2.67</b>
IIC	1.65	1.70	1.57
REI	2.11	2.11	1.86
SUI	2.00	2.08	1.61
DTK	<b>2.39</b>	2.16	2.00

*Note: mean values, N=47. The respondents were to choose among 4 degrees of influence, between great influence (level 4), some influence (level 3), little influence (level 2), and no influence (level 1). WHR = workforce and human resources, COT = components other than workforce and human resources, CUS = customers, IIT = intra-industry competition, REI = related industries, SUT = supporting industries, DTK = diffusion of technology and knowledge.*

### 5.2. Knowledge cluster directors' recognition

The directors of knowledge cluster headquarters were questioned regarding the progress of their own knowledge cluster initiatives. A total of eleven out of thirteen project directors of knowledge cluster headquarters (92.0 percent) responded with either quite satisfactory progression (25.0 percent) or satisfactory progression (66.7 percent). Furthermore, they were questioned regarding the current influential factor on the locality of their knowledge cluster. The items most frequently identified were “components other than workforce and human resources” and also “diffusion of technology and knowledge” (see table 2).

**Table 2: Evaluation of the current influential factors to the localities of clusters by project directors of knowledge cluster headquarters**

WHR	COT	CUS	IIC	REI	SUI	DTK
1.75	2.08	1.50	1.50	1.42	1.25	1.83

*Note: mean values, N=13 The respondents were to choose among 4 degrees of influence, between very satisfactory (level 4), satisfactory (level 3), little satisfactory (level 2), and unsatisfactory (level 1).*

### 5.3. Crucial cluster attributes for the cultivation of NTBFs

The question regarding cluster attributes considered important in fostering NTBFs was directed at the directors of knowledge cluster headquarters as well as external specialist, namely VCFs and the three association's group. The result is shown in table 3. In sum, knowledge cluster directors mostly identified “workforce and human resources” and “customers” as the most crucial attributes in cultivating of NTBFs. VCFs responded “workforce and human resources” the most, followed by “customers”. Lastly,

the three association's group placed "workforce and human resources" the highest, followed by "supporting industries".

**Table 3: Cluster Attributes considered important in fostering NTBFs**

	KC directors (n = 13)	VCFs (n = 32)	TAG (n = 28)
WHR	<b>2.83</b>	<b>2.81</b>	<b>2.86</b>
COT	1.83	2.09	2.07
CUS	<b>2.83</b>	<b>2.56</b>	2.38
IIC	1.67	1.59	1.89
REI	1.83	2.03	2.25
SUI	2.00	2.09	<b>2.39</b>
DTK	2.33	2.31	2.21

*Note: mean values, The respondents were to choose among different degrees of influence, between very important (level 4), important (level 3), little important (level 2), and unimportant (level 1).*

#### 5.4. Priority measures for the knowledge clusters

According to MEXT (2002b), the following concrete measures for knowledge clusters promotion are provided—"enhancing universities' functions within industry-academia-government cooperation (EUF)", "clarifying regional peculiarities(CRP)", "respecting the independence of regional communities (RIR)", "introducing the elements of interregional competition (IEI)", "including participation of experts and venture capitalists (IPE)", "introducing a mechanism of customer needs feedback (IMC)", "effectively utilizing existing facilities and measures (EUE)", "establishing rules used in handling intellectual property rights (ERI)".

In this study, questions regarding the priority of measures were addressed to NTBFs, VCFs, the three association's group, and project directors of knowledge cluster headquarters, namely to find out which measures are perceived to be crucial measure to the development of knowledge clusters.

Knowledge cluster directors put higher priority on respecting the "independence of regional communities" and "introducing a mechanism of customer needs feedback". At the same time, NTBFs believe knowledge cluster headquarters should prioritize the "introduction of customer needs feedback mechanism" and "enhancement of universities' functions within industry-academia-government cooperation". VCFs also place high priority on the "introduction of a customer needs feedback mechanism" followed by the "inclusion of experts and venture capitalists participation", while the three association's group prioritizes the "inclusion of experts and venture capitalists participation" and "establishment of rules used in handling intellectual property rights".

NTBFs put relatively high preferences not only on the "enhancement of universities' functions within industry-academia-government cooperation", but also on the "effective utilization of existing facilities and measures". This shows that NTBFs have request to maximize the potential use of universities, existing facilities and measures. VCFs and the three association's group, on the other hand, expressed their

expectation to the increase in “inclusion of experts and venture capitalists participation”.

The difference between NTBFs and the project directors of knowledge clusters is the attitude toward respecting the independence of regional communities. While project directors of regional clusters attach high priority to “respecting the independence of regional communities”, NTBFs consider it much less important.

**Table 4: Prioritization of measures for knowledge clusters**

	KC directors (n = 12)	NTBFs (n = 47)	VCFs (n = 32)	TAG (n = 28)
EUF	41.7	<b>42.6</b>	50.0	60.7
CRP	41.7	21.3	37.5	39.3
RIR	<b>66.7</b>	17.0	18.8	32.1
IEI	0.0	6.4	6.3	17.9
IPE	41.7	29.8	<b>65.6</b>	<b>85.7</b>
IMC	<b>58.3</b>	<b>42.6</b>	<b>78.1</b>	57.1
EUE	25.0	38.3	28.1	50.0
ERI	50.0	38.3	37.5	<b>71.4</b>

*Note: in percentage. EUF = enhancing universities' functions within industry-academia-government cooperation, CRP = clarifying regional peculiarities, RIR = respecting the independence of regional communities, IEI = introducing the elements of interregional competition, IPE = including participation of experts and venture capitalists, IMC = introducing a mechanism of customer needs feedback, EUE = effectively utilizing existing facilities and measures, ERI = establishing rules used in handling intellectual property rights.*

## 6. Summary and Discussion

### 6.1. Summary

Based on the surveys conducted, following findings regarding cluster features can be summarized. Firstly, regarding cluster features identified of being importance in locating each of the company's functions, “diffusion of technology and knowledge” is most highly valued, followed by “customers” for function of basic research,” customer” and “workforce and human resources” for product development function and “customer”, “workforce and human resources” and “components other than workforce and human resources” for sales function localities. Secondly, while not only NTBFs but also both external specialists and knowledge cluster project directors recognize the importance of “workforce and human resources” in the cultivation of NTBFs in the clusters, components other than workforce and human resources typified by the development of necessary infrastructure such as communication and distribution systems are being progressed more in reality, according to the recognition of knowledge cluster directors. Lastly, NTBFs put relatively high preference not only on the “enhancement of universities’ functions within industry-academia-government cooperation”, but also on the “effective utilization of existing facilities and measures”.

## 6.2. Discussion

There may be two difficulties in operating knowledge clusters. First, a knowledge cluster project director from private sector mentioned in an interview, “In carrying out the knowledge cluster project, it is necessary to cooperate with related companies, local governments, and universities. In order to acquire the cooperation of these firms and organizations, we must respect their intentions and make necessary adjustments”. This reveals the most difference between knowledge cluster operation and corporate management where top-down management is possible. In the case of knowledge cluster, there is a difficulty in coordinating among parties involved in cluster operations.

Second, many knowledge cluster directors interviewed recognized that the knowledge cluster initiative is a project with only limited human resources and it is necessary to prioritize measures used in promoting this initiative. Cluster features concerned among NTBFs vary from stage to stage. The earlier and closer to basic research the stage, the higher the value placed on “technology and knowledge diffusion”. However, as the commercialization process proceeds, more concern is placed on “customer”. Thus, in order to provide NTBFs with an optimum condition for each stage of commercialization from basic research through product development and sales, it is necessary to develop a wide range of supporting environments from technology and knowledge diffusion to “customer”.

This study highlights some key measures concerning the operation of knowledge clusters in which high priority can be ascribed for a specific time. The policy implications concerning prioritized measures aiming at fostering NTBFs for the knowledge cluster initiative can be summarized as followed. Firstly, while all NTBFs, knowledge cluster directors, and external specialists value “workforce and human resources” highly among other cluster components, project directors reveal that this component still does not yet reach a satisfactory level at present. Having completed the development of hardware and system, the knowledge cluster initiative must now embark upon the next phase, the propriety development of workforce and human resources. Secondly, “components other than workforce and human resources” typified by the development of necessary infrastructure such as communication and distribution systems are far ahead other factors influencing knowledge clusters. However, NTBFs reveal request in maximizing the potential use of universities’ function, existing facilities and measures. This shows that although there are a relatively large number of universities, existing facilities and measures developed under past regional policies, such universities’ function, existing facilities and measures are not yet operated effectively. Knowledge clusters should attempt to utilize the universities’ function, existing facilities and measures flexibly and freely based on changes of economic and social conditions.

The success or failure of knowledge clusters around the nation plays a critical role in the vitalization of local economies. For this reason, the flexible and effective uses of existing facilities, as well as the enhancement of human resources development are recommended to be prioritized for the fostering of NTBFs in knowledge clusters.

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